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COMPUTER  
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179 Water Street,  
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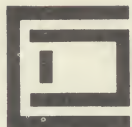
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**DC AMPLIFIERS AND  
ANALOG PROCESS SIMULATORS**

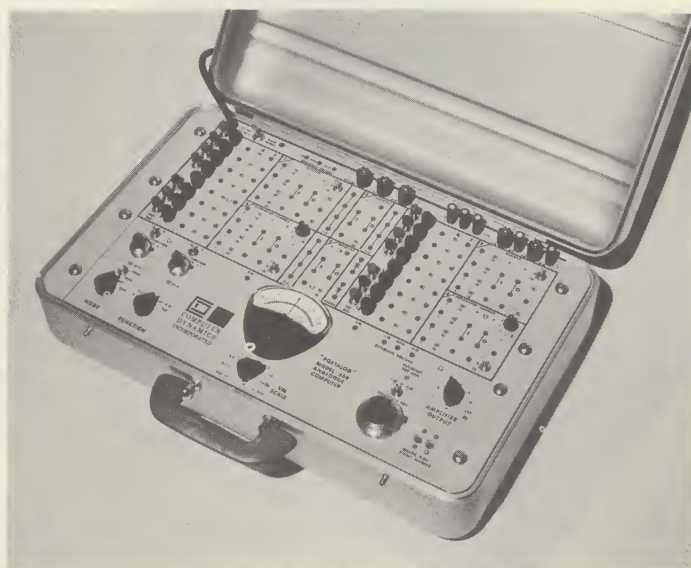


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SPECIFICATION NO. 140  
"PORTALOG" MODEL 600  
COMPACT ANALOG COMPUTER

#### FEATURES:

- ALL SOLID-STATE
- MOST COMPACT AVAILABLE
- NEW "GRAPH-PLOT" MODE  
ELIMINATES NEED FOR  
EXTERNAL PLOTTER
- FULLY SELF-CONTAINED
- EXPANDABLE
- "REAL" TIME MODE
- "SLOW" TIME MODE
- REPETITIVE MODE



The "Portalog" Model 600 Compact Computer is a six-amplifier, fully-transistorized  $\pm 10$  volt analog computer designed for convenience. It may be hand-carried anywhere in its rugged, rain-proof aluminum attache case, and is ready to operate immediately after connection to any standard 117 volt 50/60 cycle AC outlet. It may also be removed from its case and mounted in a standard relay rack of 19" width. It may be operated in tandem with another  $\pm 10$  volt computer or may be expanded by adding additional components in a rack installation. The amplifiers may be used conveniently as part of special instrumentation set-ups instead of as a computer.

The programming of the computer is on a conventional basis. It has all the control features of much larger computers, making it an ideal unit for instruction in the principles and applications of analog computers. A major feature is a new "Graph-Plot" mode of operation furnishing data in a most convenient form for recording problem solutions on graph paper and making unnecessary the use of any external recorder with the computer. Points are simply read off on the built-in meter at regular periodic intervals and are identified by an automatic counter. An external x-y plotter or oscilloscope may be used with the computer if desired.

No external plug-in resistors or capacitors are required to program the computer. Amplifier inputs and outputs are available so that special functions can be set up by means of patch cords. Input resistors and feedback resistors and capacitors are mounted internally. Feedback resistors and capacitors are selected simply by means of switches. All attenuators may be monitored without disturbing the patching by means of push-button switches which connect them to a "Pot Bus" which can be either read out on the meter or nulled against a precise reference potentiometer.

Repetitive operation with variable compatible initial conditions is another major feature of the "Portalog". Operation may be switched over to "Rep-Op" merely by switching in smaller feedback capacitors in the integrators.

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## "IPAC" INDUSTRIAL PROCESS ANALOGIC COMPUTERS

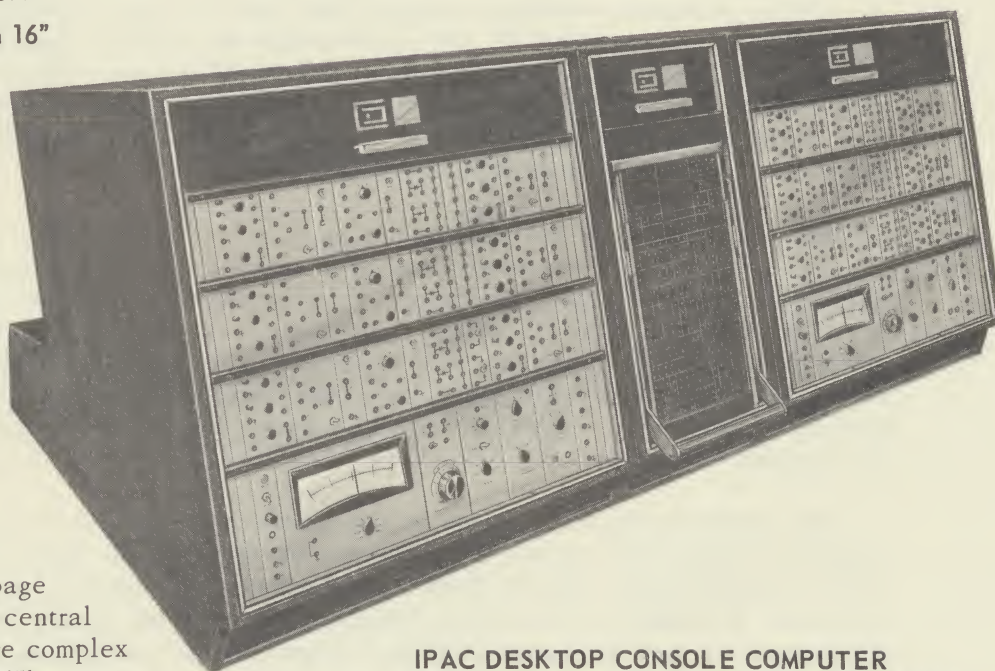


The designer of controls for industrial processes may simulate all or part of a process or its controls on a Portalog 600A (*See CDI Specification 200*) which is an evolution of the Portalog 600 into modular form. "The Portalog 600A may be expanded into a ten-amplifier general purpose linear computer, all still contained in a compact rugged case, weighing about thirty pounds complete. The same modular components may be assembled into the console shown at the left.

### IPAC DESKTOP CONSOLE COMPUTER

*Expandable to 14 amplifiers*

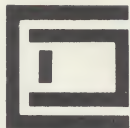
**Height 24", Width 21", Depth 16"**



### IPAC DESKTOP CONSOLE COMPUTER WITH 680 HOLE REMOVABLE PATCHBOARD

*Expandable to 28 amplifiers by adding the additional console to the right of the patchbay.*

The consoles shown on this page lend themselves admirably to central computer facilities where more complex problems may be programmed. The removable patchbay adds flexibility with great economy.  
*See CDI Specification 200 for details.*



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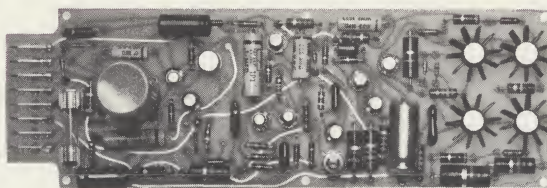
SPECIFICATION NO. 120  
MODELS 2050, 2051  
SOLID-STATE DC  
OPERATIONAL AMPLIFIERS

D.C. OPERATIONAL AMPLIFIER SPECIFICATIONS

MODELS 2050, 2051

FEATURING

ALL SOLID STATE DESIGN



WIDE BANDWIDTH

$\pm 50V$ , 30ma OUTPUT SWING

20 KC FULL OUTPUT CAPABILITY

LOW OUTPUT IMPEDANCE

OVERLOAD PROTECTION

HIGH INPUT IMPEDANCE

CHOPPER STABILIZED

HIGH GAIN

LOW NOISE

ADJUSTABLE OFFSET

LOW COST (\$225 1-24)

The 2050 series operational amplifier is a rugged, versatile module which combines time-proven elements with modern solid state technology to bring forth a new class of high performance, low cost computing components. The high output voltage in conjunction with the minute drift and noise permit a dynamic operating range typically in excess of 120 db. The large output current available allows many loads to be driven without degrading performance. The 20 KC full output capability makes the series 2050 an ideal swinging reference in hybrid computer systems.

In addition, the high input impedance, low input capacitance, 6 db per octave roll-off and 2 Mc crossover frequency all combine to simplify using this amplifier with any feedback element.

The model 2050 amplifier is constructed on a 7 x 2½ inch printed circuit board. The Model 2050 is fabricated with solder terminals as the input-output and supply connections for those applications where the amplifier will be permanently wired in. The Model 2051 is packaged for use with 8 pin ELCO VARICON connectors.

The series 2050 uses a mechanical chopper for low cost and simplicity. Models with transistor chopper and photo choppers will be available at slightly higher prices.

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# SPECIFICATIONS (2-1-64)

## SERIES 2050

VOLTAGE SWING	$\pm 50V$
OUTPUT CURRENT (See Figure 1)	30 ma
LOWEST LOAD RESISTANCE WITHOUT DEGRADING SPECS	1 K
GREATEST LOAD CAPACITANCE WITHOUT DEGRADING SPECS	500 pf
MAXIMUM FREQUENCY WITH $\pm 50V$ SWING	20KC
MAXIMUM OUTPUT VOLTAGE SWING RATE	$6 \times 10^6$ volts/sec
OPEN LOOP OUTPUT IMPEDANCE	150 OHMS
BANDWIDTH (Open Loop Gain Equals Unity) (Gain of Minus One, 50 K Components)	2 Mc 3 db down at 1 Mc
GAIN	$10^7$ at DC
ROLL OFF (To Below Unity Gain)	6 db per octave
INPUT IMPEDANCE (DC)	1 Meg
INPUT CAPACITANCE, MODEL 2050	9 pf
DRIFT (15°C-35°C) (per day)	$\pm 100 \mu V$
OFFSET ADJUST	150 $\mu$ volt per volt of trim
VOLTAGE NOISE (Referred to Input)	200 $\mu V_{pp}$
CURRENT NOISE (Referred to Input)	1 napp
DC INPUT CURRENT	$10^{-11}$ amp
SUPPLY REQUIREMENTS	+75 VDC @ 20 ma + POS Load Current -75 VDC @ 20 ma + NEG Load Current 6.3 VAC, 60 cycles

MODEL 2050 is interchangeable with the Philbrick USA-3, terminal-for-terminal, mechanically and electrically, except for DC supply voltage and output swing.

MODELS 2050-400, 2051-400 are all-silicon 400 cycle units for aircraft service at somewhat higher prices.

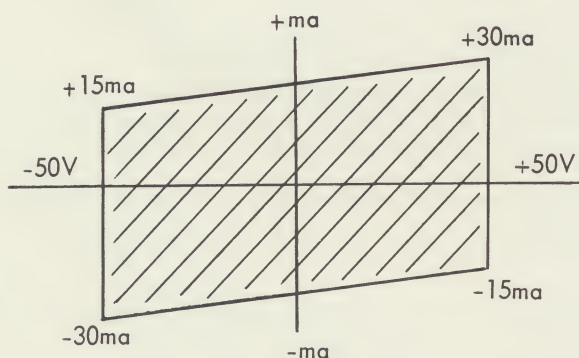


Fig. 1.  
Series 2050 - Output  
Voltage vs Current Capability  
Output Safety Fuse (see photo)  
has been replaced by new  
automatic fuseless overload  
protection on all amplifiers.

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179 WATER STREET, TORRINGTON, CONN.

Printed in U.S.A.



# COMPUTER DYNAMICS INCORPORATED

SPECIFICATION NO. 130  
SERIES 2050  
±50V SOLID STATE DC  
OPERATIONAL AMPLIFIERS

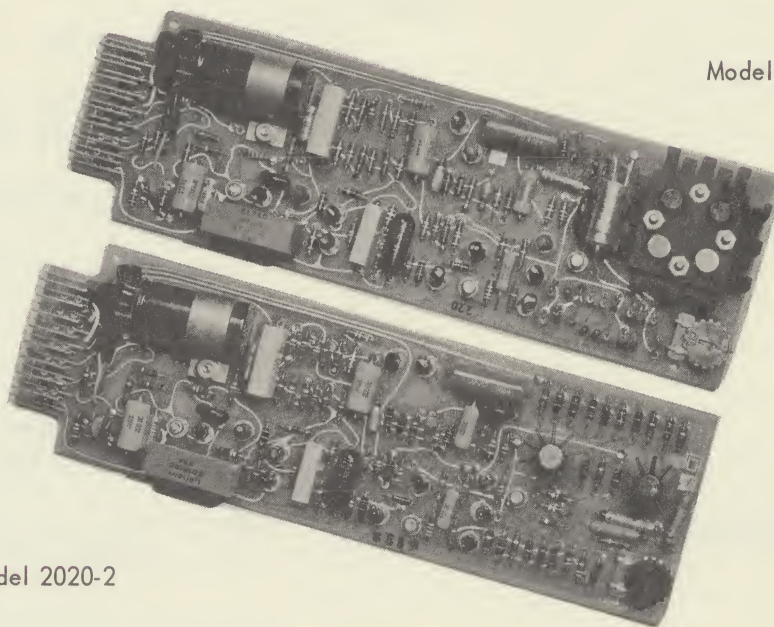
CDI AMPLIFIER SPECIFICATIONS				
MODEL NUMBER	2050 (2051)	2050 - 400 (2051 - 400)	2050 - U (2051 - U)	2052
CHARACTERISTIC APPLICATIONS	General-Purpose Chopper Stabilized	Airborne Chopper Stabilized	General-Purpose Unstabilized	Systems Plug-in with Photochopper
PRICE (1-24 pcs.)	\$225	\$275	\$175	\$245
DELIVERY	Stock to 6 wks.	Stock to 6 wks.	Stock to 6 wks.	Stock to 6 wks.
SIZE (inches) L W H	7 (7 3/4) 2 1/2 2 7/16	7 (7 3/4) 2 1/2 1	7 (7 3/4) 2 1/2 1	8 4 1/2 1
Connections	Solder terminals (8-Contact Varicon)	Solder terminals (8-Contact Varicon)	Solder terminals (8-Contact Varicon)	18-Contact Varicon
Output Voltage Output Current	±50 V ±30 ma	±50 V ±30 ma	±50 V ±30 ma	±50 V ±30 ma
Power requirement	±75 V at 25 ma plus load current	±75 V at 25 ma plus load current	±75 V at 25 ma plus load current	±75 V at 30 ma plus load current
Chopper drive (external)	6.3 Vac, 60 cps, 33 ma	6.3 Vac, 400 cps, 25 ma	None	None
Chopper	60 cps. mech. 2,000 hr. life	400 cps. mech. 10,000 hr. life	None	Photochopper 10,000 hr. life
Max. freq. for ±50V swing	20 KC	20 KC	20 KC	20 KC
Lowest load resistance without degrading spec's.	1 K	1 K	1 K	1 K
Greatest load capacitance without degrading spec's.	500 pf.	500 pf.	500 pf.	500 pf.
Maximum output voltage swing rate	6x10 <sup>6</sup> Volts/Sec.	6x10 <sup>6</sup> Volts/Sec.	6x10 <sup>6</sup> Volts/Sec.	6x10 <sup>6</sup> Volts/Sec.
Open loop output impedance	150 ohms	150 ohms	150 ohms	150 ohms
Freq. of unity open loop gain	2 mc	2 mc	2 mc	2 mc
3 db freq. (50K comp.) at unity gain	1 mc	1 mc	1 mc	1 mc
Roll off to below unity gain	6 db/octave	6 db/octave	6 db/octave	6 db/octave
DC gain	10 <sup>7</sup>	10 <sup>7</sup>	10 <sup>5</sup>	10 <sup>7</sup>
Input Impedance	1 Meg	1 Meg	1 Meg	1 Meg
Drift (15°C - 35°C)	±100 μV	±100 μV	±5 mV	±100 μV
Offset adjustment sensitivity	150 μV/V	150 μV/V	1.5 mV/V	(Internal trimmer)
Voltage noise referred to input	All models: 0-50cps, 50 μV p-p; 0-1KC, 100 μV p-p; 0-10KC, 300 μV p-p; 0-100KC, 1 μV p-p			
Current noise referred to input	1 na (p-p)	1 na (p-p)	1 na (p-p)	1 na (p-p)
DC Input current	10 <sup>-11</sup> amp.	10 <sup>-11</sup> amp	10 <sup>-7</sup> amp	10 <sup>-11</sup> amp
Offset sensitivity to supply voltage	50 μV/Volt	50 μV/Volt	300 μV/volt	10 μV/volt
			Printed in U.S.A.	JME 6-1-64





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SPECIFICATION NO. 160  
MODELS 2020-2, 2020-3  $\pm 20\text{VDC}$   
SOLID STATE DC OPERATIONAL AMPLIFIERS



Model 2020-3

Model 2020-2

#### FEATURES

INPUT AND FEEDBACK RESISTOR MOUNT  
ON PRINTED CIRCUIT BOARD

1.5 MC BANDWIDTH

$\pm 20\text{V}$  OUTPUT SWING

OUTPUT CURRENT:

$\pm 20\text{ma}$  (Model 2020-2)

$\pm 100\text{ma}$  (Model 2020-3)

15 KC FULL OUTPUT CAPABILITY

SINGLE-ENDED INPUT AND OUTPUT

CHOPPER STABILIZED (Mech. Chopper)

FITS CDI "IPAC" MODULES  
(Industrial Process Analog Computer)

HIGH GAIN ( $10^8$  at DC)

LOW NOISE (See Detail Spec.)

INTERNAL OFFSET ADJUST

OVERLOAD SIGNAL RELAY

OUTPUT TOLERATES INDEFINITE SHORT  
CIRCUIT TO GROUND

LOW COST (See Price List)

Ideal for general purpose instrumentation, integration, or summation, Models 2020-2 and 2020-3 are plug-in solid state operational dc amplifiers designed for analog computer systems. The two models have identical performance except that the 2020-3 delivers 100ma at  $\pm 20\text{VDC}$ ; the 2020-2 delivers 20ma at  $\pm 20\text{VDC}$ . Full output capability is maintained from 0 to 15KC, rolloff is 6 db per octave, input impedance is 1 megohm, gain bandwidth is 1.5 megacycles, and gain is 160 db min. at DC. Narrow-band noise (0-50 cps) is only 50 microvolts peak-to-peak, and can be reduced to 20 microvolts p-p upon specification. A reed relay chopper overload circuit allows the systems designer to devise his own alarm system. Also available unstabilized as differential input, single-ended output (Model 2020-1).

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MODELS 2020-2, 2020-3  $\pm 20$ VDC OPERATIONAL AMPLIFIERS

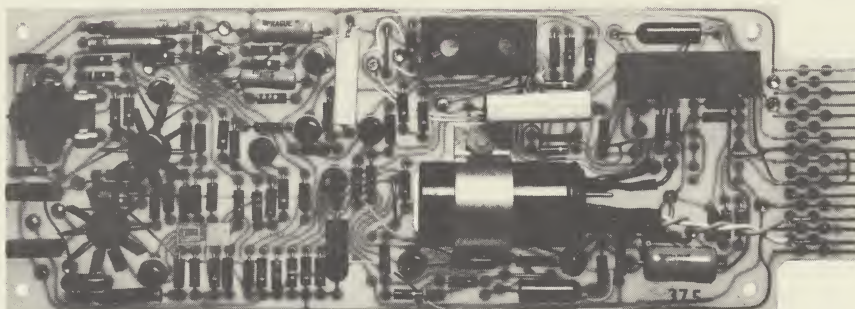
CHARACTERISTIC APPLICATIONS	Analog systems, Instruments, CDI "IPAC"
PRICE	Highly competitive (See Price List)
DELIVERY	Stock to six weeks
DIMENSIONS	2.75 x .675 x 8.781 inches (Mount on 1 inch centers in CDI "IPAC" modules)
INSTALLATION DRAWING	CDI Dwg. No. B-11578
CONNECTIONS	17-Contact Varicon; Mates with Elco 7001 Series
OUTPUT VOLTAGE	$\pm 20$ V
OUTPUT CURRENT	Model 2020-2: $\pm 20$ ma Model 2020-3: $\pm 100$ ma
POWER SUPPLY REQUIREMENT	$\pm 28$ to $\pm 30$ VDC at 15ma plus load current 6.3VAC at 33ma (for chopper drive)
CHOPPER	Mechanical 50/60 cps or 400 cps
MAX. FREQ. FOR $\pm 20$ V SWING INTO 1K LOAD	15KC
LOWEST LOAD RESISTANCE WITHOUT DEGRADING SPEC'S	1K
MAX. OUTPUT VOLTAGE SWING RATE	$2 \times 10^6$ Volts/sec.
OPEN LOOP OUTPUT IMPEDANCE	150 ohms at DC
FREQ. OF UNITY OPEN LOOP GAIN	1.5mc
ROLLOFF TO BELOW UNITY GAIN	6 db/octave (optimum for systems)
DC GAIN	160 db ( $10^8$ )
INPUT IMPEDANCE	1 megohm
DRIFT ( $0^\circ\text{C}$ to $50^\circ\text{C}$ )	$\pm 100$ microvolts (long-term)
TYPICAL DRIFT AS INTEGRATOR (1 Sec)	200 microvolts/minute at constant temp.
OFFSET ADJUSTMENT SENSITIVITY	100 microvolts/volt at REF. input $\pm 100$ microvolts via internal trimmer
DC INPUT CURRENT	$10^{-11}$ amp
OFFSET SENSITIVITY TO SUPPLY VOLTAGE	10 microvolts/volt
VOLTAGE NOISE REFERRED TO INPUT	0-50 cps: 50 $\mu\text{v}$ p-p (20 $\mu\text{v}$ p-p available) 0-10KC: 100 $\mu\text{v}$ p-p



COMPUTER  
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SPECIFICATION NO. 170  
MODELS 2010-2, 2010-1-  $\pm 10$  VDC  
SOLID STATE DC OPERATIONAL AMPLIFIERS

179 Water Street, Torrington, Connecticut, U.S.A. 06791 Tel. (203) 482-7621



Model 2010-2

#### FEATURES

1.5 MC BANDWIDTH

$\pm 10$  V OUTPUT SWING

OUTPUT CURRENT  
 $\pm 30$  ma

15 KC FULL OUTPUT CAPABILITY

SINGLE-ENDED INPUT AND OUTPUT  
(Model 2010-2)

CHOPPER STABILIZED (Mech. Chopper)  
(Model 2010-2)

FITS CDI "IPAC" MODULES  
(Industrial Process Analog Computer)

HIGH GAIN ( $10^7$  at DC) (Model 2010-2)  
200,000 at DC (Model 2010-1)

LOW NOISE (See Detail Spec.)

INTERNAL OFFSET ADJUST

OUTPUT TOLERATES INDEFINITE SHORT  
CIRCUIT TO GROUND

LOW COST (See Price List)

Ideal for general-purpose instrumentation, integration, or summation, Model 2010-2 is a chopper-stabilized plug-in solid state operational dc amplifier designed for analog computer systems. The Model 2010-2 represents a breakthrough in design for high performance and low cost. Full  $\pm 30$ ma output capability is maintained from 0 to 15KC, rolloff is 6 db per octave, input impedance is 1 megohm, gain bandwidth is 1.5 megacycles, and gain is 140 db min. at DC. Narrow band noise (0-50 cps) is only 50 microvolts peak-to-peak, and can be reduced to 20 microvolts p-p at slight extra cost upon specification. The high input impedance allows substantial cost savings for integrators, for a one-second integration time constant (1 volt/sec./volt) may be obtained with a 1 megohm input resistor and only a 1 mfd. feedback capacitor. Also available unstabilized as full differential input, single-ended output (Model 2010-1).



MODELS 2010-2, 2010-1 OPERATIONAL AMPLIFIERS

CHARACTERISTIC APPLICATIONS	Analog systems, Instruments, CDI "IPAC"
PRICE	Highly competitive (See Price List)
DELIVERY	Stock to six weeks
DIMENSIONS	2.75 x .675 x 7.50 inches (Mount on 1 inch centers in CDI "IPAC" modules)
INSTALLATION DRAWING	CDI Dwg. No. B-11628
CONNECTIONS	17-Contact Varicon; Mates with Elco 7001 Series
OUTPUT VOLTAGE	$\pm 20V$
OUTPUT CURRENT	$\pm 30ma$
POWER SUPPLY REQUIREMENT	$\pm 16$ VDC at 15ma plus load current 6.3VAC at 33 ma (for chopper drive)
CHOPPER	Mechanical 50/60 cps or 400 cps
MAX. FREQ. FOR $\pm 10V$ SWING INTO 1K LOAD	15KC
LOWEST LOAD RESISTANCE WITHOUT DEGRADING SPEC'S	1K
MAX. OUTPUT VOLTAGE SWING RATE	$2 \times 10^6$ Volts/sec.
OPEN LOOP OUTPUT IMPEDANCE	150 ohms at DC
FREQ. OF UNITY OPEN LOOP GAIN	1.5mc
ROLLOFF TO BELOW UNITY GAIN	6 db/octave (optimum for systems)
DC GAIN	140 db ( $10^7$ ) (Model 2010-2)
INPUT IMPEDANCE	1 megohm (Model 2010-2) 200 K (Model 2010-1)
DRIFT ( $0^\circ C$ to $50^\circ C$ )	$\pm 100$ microvolts (long-term)
TYPICAL DRIFT AS INTEGRATOR (1 Sec)	200 microvolts/minute at constant temp.
OFFSET ADJUSTMENT SENSITIVITY	100 microvolts/volt at REF. input $\pm 100$ microvolts via internal trimmer
DC INPUT CURRENT	$10^{-11}$ amp
OFFSET SENSITIVITY TO SUPPLY VOLTAGE	10 microvolts/volt
VOLTAGE NOISE REFERRED TO INPUT	0-50 cps: 50 $\mu v$ p-p (20 $\mu v$ p-p available) 0-10KC: 100 $\mu v$ p-p



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**MODEL C/100/M**  
**HIGH GAIN OPERATIONAL**  
**DC AMPLIFIER**

179 Water Street, Torrington, Connecticut, U.S.A. 06791 Tel. (203) 482-7621

## MODEL C/100/M

# HIGH GAIN OPERATIONAL DC AMPLIFIER

### SPECIFICATIONS

#### GAIN:

30,000 DC open loop

#### PHASE SHIFT:

(As unity inverter)  $10^\circ$  at 100 Kc,  $135^\circ$  at 1 Mc.

#### RESPONSE:

0.6 microsecond rise time with a band width over 400 Kc as a unity inverter into a 100 K resistive load. (Idealized circuit conditions)

#### DRIFT:

Less than  $\pm 5$  mv/day under normal conditions as unity inverter after 24 hr. aging period.

#### DIFFERENTIAL INPUT:

IMPEDANCE—Either input 100 Meg (Open grid)

COMMON MODE— $\pm 50$  V Max.

INPUT CURRENT—0.1 microamp (Leakage)

#### ZENER DIODE COUPLING

#### ZEROING BIAS:

-0.6 to -1.6 volts on pin 1.

#### OUTPUT:

$\pm 100$  Vdc, 33 K load (Output may be directly shorted without damage to unit).

#### CAPACITATIVE LOADING AT SUMMING JUNCTION:

(Unity inverter) Capacity 82 mmf, Band width reduced to 300 Kc.

#### FILAMENTS:

0.75 amp. at 6.3 Vac, C.T. biased at -170 Vdc.

#### BASE PLUG:

Octal (Amphenol 86—CP8—T or equivalent)

PIN 1: Plus input      PIN 5: +300 Vdc

PIN 2: Minus input    PIN 6: Output

PIN 3: -300 Vdc      PIN 7: Filaments

PIN 4: Ground        PIN 8: Filaments

#### TUBE COMPLEMENT:

(One) 12AX7 or ECC83 or 7025

(One) 6EA8

#### OUTSIDE DIMENSIONS:

Width: 3" Nominal

Depth: 1½" Nominal

Seated Height: 5¼" Max.

#### RECOMMENDED CHASSIS:

Models C/06P/3.5



The high reliability of this amplifier has been proven by years of continual use. Model C/100/M is a high-gain plug-in type of operational DC amplifier for analog computers, system simulation, and control applications. It is designed especially to provide low cost additional amplifier capacity for existing analog computer facilities, and for this purpose particular attention has been paid to its dynamic performance characteristics. Six of these amplifiers may be paired with six Model C/100/SM/CC chopper amplifiers in the Model C/06P/3.5 Operational Six-Pack Computer Building Block to provide six channels of high-gain drift-stabilized analog computation. However, the inherent drift of the Model C/100/M is low enough not to require chopper stabilization for many applications.

The amplifier case is aluminum with a flat brown finish and provides maximum shielding against stray pickup and hum. When mounted in the Operational Six-Pack Computer Building Block it may be drawn firmly against the chassis by means of #8-32 machine screws, providing maximum heat conduction away from the circuit components. The case is easily disassembled for inspection and servicing of the circuit, which is mounted on a circuit board for uniformity, compactness, and reliability.

Embree Electronics Division of Computer Dynamics Incorporated

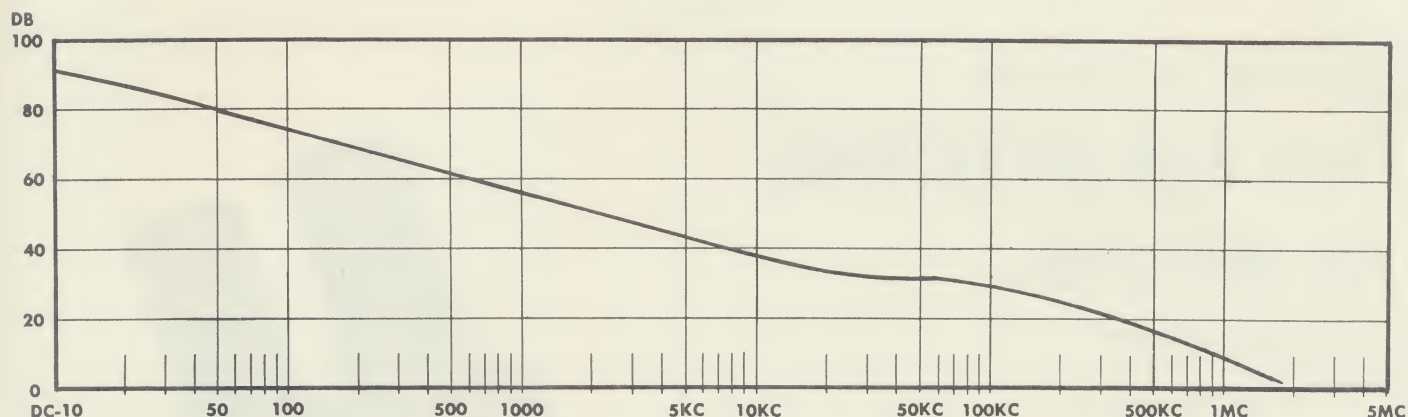


# MODEL C/100/M

## HIGH GAIN OPERATIONAL DC AMPLIFIER

### C/100/M AMPLIFIER GAIN VS. FREQUENCY

(measured at Amplifier Terminal Pins)



### CAPACITATIVE LOADING AT SUMMING JUNCTION: (Unity inverter)

Capacity 82 mmf, Band width reduced to 300 Kc.

### CAPACITATIVE LOADING AT OUTPUT: (Unity inverter)

Capacitance	Band width	Signal Amplitude
1 mfd	100 cps	18 V peak-to-peak
1 mfd	300 cps	6 V peak-to-peak
1 mfd	500 cps	3 V peak-to-peak
1 mfd	1 kc	1.5 V peak-to-peak
10 mfd	20 cps	6 V peak-to-peak
10 mfd	100 cps	1.5 V peak-to-peak

### POWER REQUIRED FOR FULL OUTPUT

Load	Output	Current +300 Vdc	Current -300 Vdc
100 K	0	10 ma	13 ma
100 K	+100 V	9	9.6
100 K	-100 V	11.6	16
50 K	+100 V	9	8.6
50 K	-100 V	11.6	16.5
33 K	+100 V	9	8
33 K	-100 V	11.6	17.2

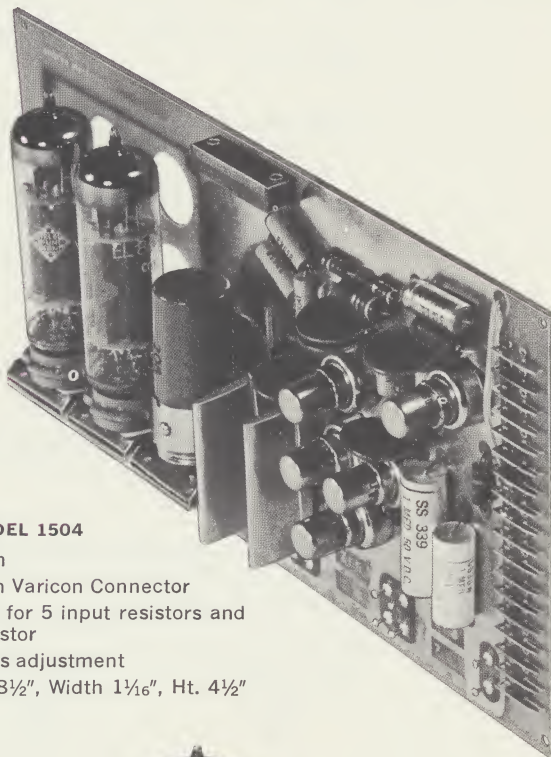


**COMPUTER  
DYNAMICS  
INCORPORATED**

**1500 SERIES "NUVAMPS"  
HIGH GAIN CHOPPER-STABILIZED  
OPERATIONAL DC AMPLIFIER**

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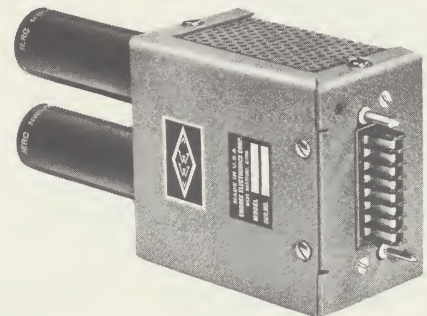
**1500 SERIES "NUVAMPS"  
HIGH GAIN CHOPPER-STABILIZED  
OPERATIONAL DC AMPLIFIER**



**MODEL 1504**

- 750 KC Bandwidth
- 18-Pin Elco Plug-in Varicon Connector
- Rugged standoffs for 5 input resistors and one feedback resistor
- Self-contained bias adjustment

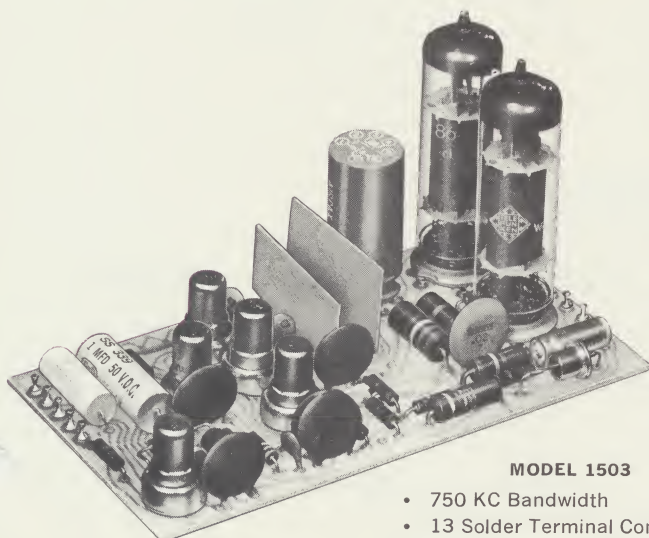
Dimensions: Length 8½", Width 1½", Ht. 4½"



**MODEL 1501**

- 750 KC Bandwidth
- Rugged Metal Case
- 16-Pin No. 26-190-16 Blue-Ribbon Connector

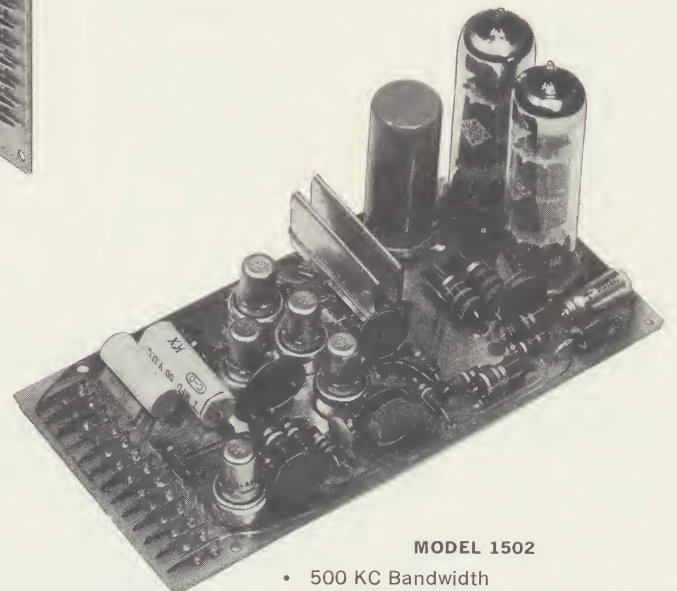
Dimensions: 2" x 3" x 7" O.A.



**MODEL 1503**

- 750 KC Bandwidth
- 13 Solder Terminal Connections

Dimensions: Base 3" x 5½", Ht. 3"



**MODEL 1502**

- 500 KC Bandwidth
- 13-Pin Elco Plug-in Varicon Connector

Dimensions: Base 3" x 6.10", Ht. 3"

Embree Electronics Division of Computer Dynamics Incorporated



# 1500 SERIES "NUVAMPS"

## HIGH GAIN CHOPPER-STABILIZED OPERATIONAL DC AMPLIFIER

- 1 VERSION MAX TOLERANCE TO CAPACITIVE LOADING \* 5KC FULL POWER OUTPUT
- 2 VERSION MODERATE TOLERANCE TO CAPACITIVE LOADING, 15KC FULL POWER OUTPUT
- 3 VERSION TOLERATES ALL VALUES OF FEEDBACK R & C, 25KC FULL POWER OUTPUT

### SPECIFICATIONS

(DATA FOR MODELS 1501, 1502, 1503, and 1504)

#### OUTPUT VOLTAGE RANGE:

- ± 100 Vdc into 6.8K Load
- ± 150 Vdc into 100K Load

#### DC GAIN: (Open-loop)

- No load: 70 million
- 6.8K load: 50 million

#### DRIFT:

- Less than 100 microvolts/24 hrs.

#### CURRENT OUTPUT CAPABILITY

- (Small Signal Transient Conditions as unity inverter,  $R_i = R_f = 150K$ )

Voltage Swing	Plus Output	Negative Output
10 Vdc	+ 50 ma	- 20 ma

#### SENSITIVITY TO ±300 VOLT POWER SUPPLY VARIATIONS:

- 1% variation in either ± 300 Vdc alone causes 300 microvolt S. J. offset.
- Will maintain ± 100 Vdc output swing from ± 280 Vdc to ± 345 Vdc.

#### \* CAPACITIVE LOADING TOLERANCE -1 VERSION

(As unity inverter,  $R_i = R_f = 150K$ )

On Summing Junction	On Output
1500 mmfd	Up to .004 mfd
800 mmfd	Up to .006 mfd
150 mmfd	Up to .0075 mfd
100 mmfd	Up to .1 mfd
85 mmfd	Up to .1.0 mfd
80 mmfd	Unlimited

#### PLATE POWER REQUIREMENTS:

6.8K OUTPUT LOAD

#### VOLTAGE

	Zero V Out	+100V Out	-100V Out
+ 300Vdc	+ 15 ma	+ 27 ma	+ 8 ma
- 300Vdc	- 12 ma	- 9 ma	- 19 ma
Total ± 300 Power	8.1 watts	10.8 watts	8.1 watts

#### FILAMENT POWER REQUIREMENTS:

- 6.3 Vac C.T. grounded, 0.81 amp. (6CW5's and chopper)
- 6.3 Vac C.T.-170 Vdc, 0.81 amp. (6CW5's)
- 6.3 Vac C.T. grounded 0.75 amp. (6CW4's)

#### TUBE COMPLEMENT:

- (2) 6CW5 (9-Pin Miniature Triode-Pentode)

#### NUVISTOR COMPLEMENT:

- (5) 6CW4 Triode:  $\mu$  of two 6CW4's in stabilizer section should be approximately equal for highest gain.

#### OFFSET AT SUMMING JUNCTION: (Typical)

- 550 Microvolts as unity inverter with input grounded (no external bias)

#### NOISE (Referred to Summing Junction):

Bandwidth	V peak to peak
10KC	1mV
1KC	500 $\mu$ V
50 cps	300 $\mu$ V

### FREQUENCY CHARACTERISTICS

VERSION	UNITY GAIN CROSSOVER	PHASE MARGIN	ROLLOFF	NO LOAD	VELOCITY LIMIT 20K LOAD	6.8K LOAD
-1	6 MC	10°	Tailored for Maximum Tolerance to Capacitive Loading	20KC	15KC	5KC
-2	6 MC	10°	Tailored for Moderate Tolerance to Capacitive Loading	25KC	20KC	15KC
-3	4 MC	45°	6 db/octave	35KC	30KC	25KC



**COMPUTER  
DYNAMICS  
INCORPORATED**

**1700 SERIES  
OPERATIONAL DC AMPLIFIERS**

179 Water Street, Torrington, Connecticut, U.S.A. 06791 Tel. (203) 482-7621

# MODEL 1700 SERIES OPERATIONAL DC AMPLIFIERS

## SPECIFICATIONS

### MODEL DESIGNATIONS:

#### MODEL

1701	UNSTABILIZED DC AMPLIFIER
1702	STABILIZING DC AMPLIFIER
1703	UNSTABILIZED DC AMPLIFIER
1701/S	STABILIZED (1701 + 1702)
1703/S	STABILIZED (1703 + 1702)

(Data for Stabilized Models 1701/S and 1703/S)

### OUTPUT VOLTAGE RANGE:

±100 Vdc into 20 K Load  
±150 Vdc into 100 K Load

### DC GAIN:

No load: 45 million  
33 K load: 18 million

### DRIFT:

Less than 100 microvolts/24 hrs.

### BANDWIDTH:

(Frequency at which ±100 Volts output is down 3db)

GAIN	VALUE OF INPUT AND FEEDBACK RESISTORS	BANDWIDTH		VELOCITY LIM.
		No Load	33 K Load	33 K Load
Unity	Ri = Rf = 150 K	470 KC	470 KC	45 KC
10	Ri = 15K, Rf = 150 K	250 KC	220 KC	50 KC
15	Ri = 10K, Rf = 150 K	220 KC	200 KC	50 KC
1000	Ri = 10K, Rf = 10 meg.	1.6 KC	1.3 KC	50 KC

### CURRENT OUTPUT CAPABILITY (Small Signal Transient Conditions as unity inverter, Ri = Rf = 150 K)

VOLTAGE SWING	PLUS OUTPUT	NEGATIVE OUTPUT
10 Vdc	+6.7 ma	-30 ma
6 Vdc	+8.8 ma	-40 ma
4 Vdc	+8.5 ma	-40 ma
2 Vdc	+9.1 ma	-42 ma
1 Vdc	+6.7 ma	-45 ma

### SENSITIVITY TO ±300 VOLT POWER SUPPLY VARIATIONS:

1% variation in either ±300 Vdc alone causes 300 microvolt S.J. offset. Will maintain ±100 Vdc output swing from ±280 Vdc to ±345 Vdc.

### PLATE POWER REQUIREMENTS:

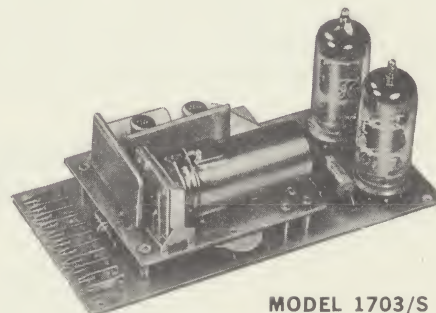
VOLTAGE	NO OUTPUT LOAD		
	Zero Volts out	+100 V out	-100 V out
+300 Vdc	+16 ma	+13 ma	+19 ma
-300 Vdc	-13 ma	-10 ma	-17 ma
VOLTAGE	20 K OUTPUT LOAD		
	Zero Volts out	+100 V out	-100 V out
+300 Vdc	+16 ma	+13 ma	+19 ma
-300 Vdc	-13 ma	-5 ma	-22 ma

### FILAMENT POWER REQUIREMENTS:

6.3 Vac C.T. Gnd; .30amp.  
6.3 Vac C.T.—170 Vdc, .45 amp.

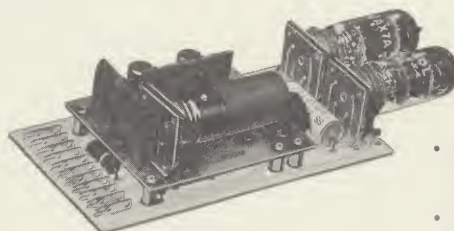
### TUBE COMPLEMENT IN MODELS 1701 and 1703:

- (1) 7025 (9-Pin Miniature)
- (1) 6EA8 (9-Pin Miniature)



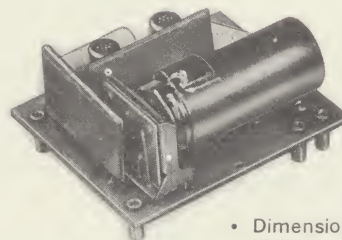
**MODEL 1703/S**

- Compact model for chassis mounting
- 11-Pin Elco Varicon connector
- Dimensions: 5½ long x 2.65 wide x 2¼ high



**MODEL 1701/S**

- Flat model for 1700/06P/3.5 Operational Six-Pack and ASAP/3.5 Analog System Assembly Pack
- Dimensions: 6½ long x 2.65 wide x 1½ high



**MODEL 1702**

- "Piggy-back" chopper-stabilizing amplifier for use with Models 1701 and 1703
- Dimensions: 2.85 long x 2.475 wide x 1½ high

See Dwg. C-1187 for Installation Assembly of 1701, 1702, 1703, 1701/S, 1703/S.

### NUVISTOR COMPLEMENT IN MODEL 1702:

(2) 6CW4 Triode: mu must test in range of 75 to 90.

### CAPACITIVE LOADING TOLERANCE (As unity inverter,

Ri = Rf = 150 K)

ON SUMMING JUNCTION	ON OUTPUT
300 mmfd	Up to .2 mmfd
100 mmfd	Up to .3 mmfd
47 mmfd	Up to .6 mmfd
40 mmfd	Up to .001 mfd
37 mmfd	Up to .010 mfd
33 mmfd	Up to 10 mfd

### PHASE SHIFT:

Rf = Ri = 1 meg: 10° at 26 KC  
Rf = Ri = 150 K: 10° at 130 KC  
Rf = Ri = 100 K: 10° at 155 KC

### OFFSET AT SUMMING JUNCTION:

550 Microvolts as unity inverter with input grounded (no external bias)

### OUTPUT NOISE:

Wide-band less than 2 mv peak-to-peak. (200 microvolts rms)

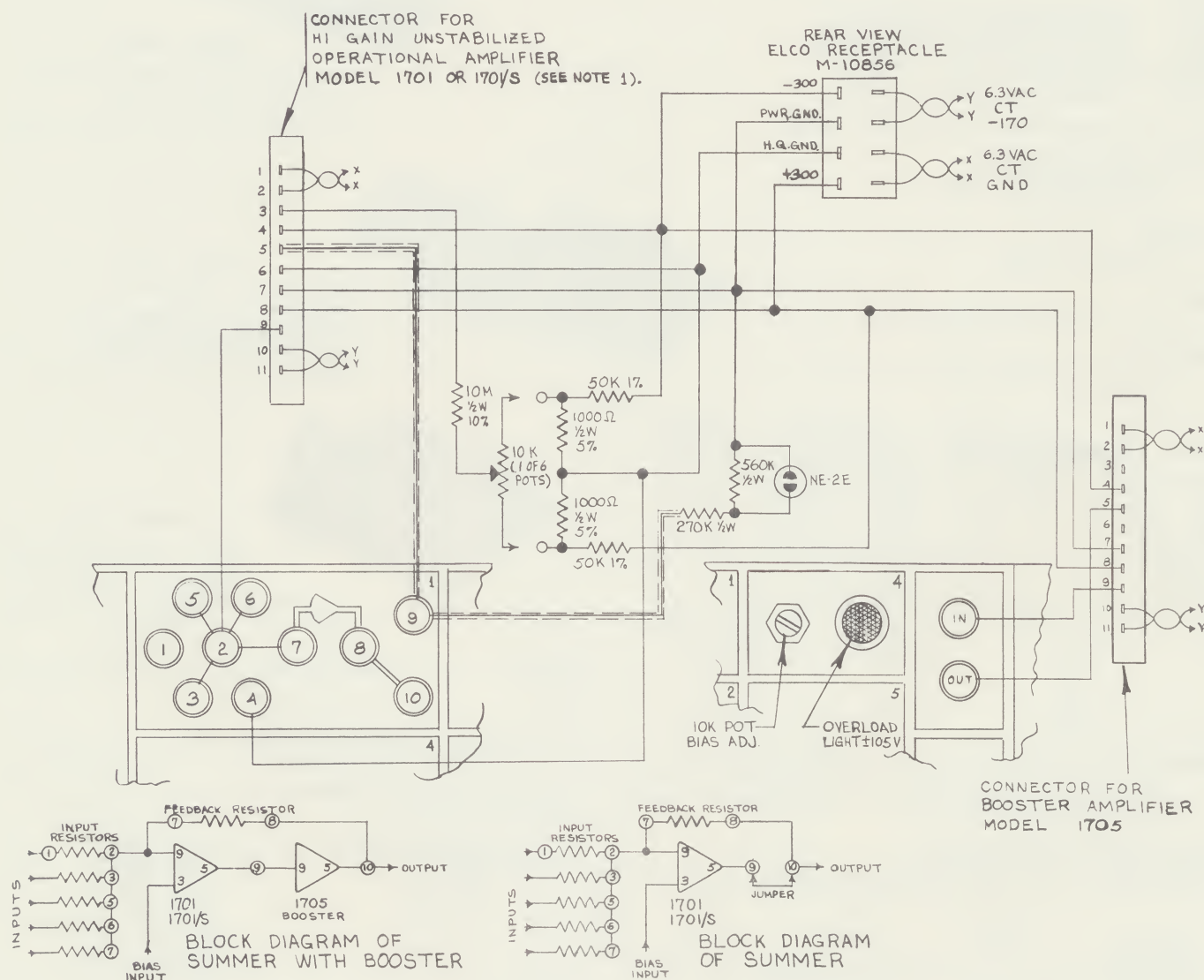
Embree Electronics Division of Computer Dynamics Incorporated



# MODEL 1700 SERIES OPERATIONAL DC AMPLIFIERS

The Models 1701 and 1703 printed circuit operational dc amplifiers are low-noise, low-drift amplifiers and will deliver 5 ma at  $\pm 100$  Vdc into a 20 K load. They are used in measuring instrumentation, analog simulators and computers, and for servo and recorder drive applications. When the Model 1702 "Piggy-back" chopper-stabilizing amplifier is added to Models 1701 and 1703, (simply cut out red jumpers and screw to the board with screws provided) the long-term drift is reduced to under 100 microvolts and open-loop dc gain is increased from a nominal 30,000 to over 30 million. The unstabilized dc gain is achieved without use of positive feedback, increasing the versatility, the usefulness, and the simplicity of circuits in which these amplifiers may be used.

## SCHEMATIC DIAGRAM OF USE OF 1700 SERIES AMPLIFIERS IN MODEL 1700/06P/3.5 OPERATIONAL SIX-PACK.



### NOTES

1. NO WIRING CHANGES ARE REQUIRED IN THE MODEL 1700/06P/3.5 OPERATIONAL SIX PACK WHEN STABILIZED OPERATION IS DESIRED. THE UNSTABILIZED MODEL 1701 MAY BE STABILIZED (MODEL 1701/S) BY ADDING MODEL 1702 ACCORDING TO INSTRUCTIONS ON INSTALLATION DRAWING NO. C-1187. NO ADDITIONAL WIRING IS REQUIRED.
2. STANDARD  $\frac{3}{4}$ " SPACING ONLY BETWEEN TERMINALS, 1 & 2, 3 & 4, 5 & 6, 7 & 8, 9 & 10.



COMPUTER  
DYNAMICS  
INCORPORATED

SPECIFICATION NO. 190  
MODEL SDA-10  
CHOPPER STABILIZED DIFFERENTIAL  
OPERATIONAL AMPLIFIER

The Model SDA-10 is a new and unique addition to the capabilities of modern operational amplifiers. It offers the full differential characteristics of unstabilized amplifiers (such as the CDI Model 2010-1) while including the greatly reduced input drift attainable only through the use of chopper stabilization. It does this without resorting to such frequency limiting techniques as the use of chopper transformers or floating power supplies, and with performance far superior to that attainable with chopper transistors. The basis for these remarkable characteristics is a new, proprietary, floating photo-chopper circuit which truly advances amplifier capabilities.

The salient specifications are listed below:

Dimension	4.50 x 8.00 inches (Mount on 1 inch centers in CDI "IPAC" modules)
Connections	18 pin Varicon
Output Voltage	$\pm 10V$
Output Current	$\pm 30$ ma
Power Supply Requirement	$\pm 16VDC$ at 15 ma plus load current $115VAC$ for chopper drive
Max. Freq. for $\pm 10V$ Swing into 1K load	15KC
Lowest Load Resistance without Degrading Specs	1K
Open Loop Output Impedance	150 ohms at DC
Gain Bandwidth Product (Open Loop)	1.5MC
Rolloff to Below Unity Gain	6 db/octave
DC Gain	140 db ( $10^7$ ) Min.
Input Impedance - Common Mode	1000 Megohm at DC
Differential	400K at DC
As a Voltage Follower	100,000 Megohm at DC
Drift ( $0^\circ C$ to $50^\circ C$ )	$\pm 100$ microvolts (long term)
DC Input Current Neg. Input	$10^{-11}$ amp
Pos. Input	$10^{-9}$ amp
Voltage Noise (Referred to Input)	0-50 cps: 50 $\mu V_{pp}$ (20 $\mu V_{pp}$ available) 0-10KC: 100 $\mu V_{pp}$

These preliminary specifications are subject to change without notice.

1/28/65

Printed in U.S.A.





**COMPUTER  
DYNAMICS  
INCORPORATED**

SPECIFICATION NO. 210  
Model 2010-1D Dual Amplifier  
+10V Differential, Unstabilized  
Solid State DC Operational

CHARACTERISTIC APPLICATIONS: ANALOG SYSTEMS, SIMULATORS, CONTROLLERS, COMPUTERS

This unit is a dual amplifier (two separate, individual, non-interacting circuits) on a single printed circuit card. The dimensions are  $6\frac{1}{2}$ " long x  $4\frac{1}{2}$ " wide. The unit fits into the "System-Mate" rack housing in a module 1" wide x  $5\frac{1}{4}$ " high x approximately 10" deep. Sixteen modules (32 amplifiers) may be mounted in a single standard rack housing (Model IPAC-5) which is 19" wide x  $5\frac{1}{4}$ " high x 15" deep.

FEATURES (Each of two amplifiers)

1. Unity gain crossover 1.5 megacycles (open loop).
2. Full differential input (You can do practically as much with the positive input as with the negative input).
3. Full output current  $\pm 30$  ma over entire output voltage range (+10V).
4. Output voltage range  $\pm 10V$  at full load ( $\pm 30$  ma).
5. 15KC full output capability.
6. Input impedances: Common mode; greater than 10 megohms  
Differential between inputs; greater than 300K
7. Drift less than 50 microvolts per°C.
8. DC gain greater than 200,000 with 330 ohm load.
9. Low noise.
10. Internal zero offset adjustment (external also available).
11. Overload protection for input and output.
12. All silicon transistors.
13. Power supply voltages  $\pm 16$  VDC.
14. May be chopper stabilized as a single-ended amplifier by pairing with any of the Model 2000 Series Stabilizing Amplifiers.

Printed in U.S.A.

The Model HIP-10 is a new and versatile entry to the field of positive follower amplifiers. It combines the use of a unique and proprietary floating photo-chopper stabilizer with a high quality differential amplifier to yield a device unparalleled for potentiometric applications. The ratio of input to output impedance is substantially greater than  $10^{14}$ . The gain accuracy is better than one part in  $10^5$ . There is no limitation on the source impedance used with this amplifier and since the input capacitance is less than 10 pf, a source with one megohm impedance would be attenuated by the amplifier less than 3 db at 15KC.

The outstanding specifications (at 25°C unless specified) are listed below:

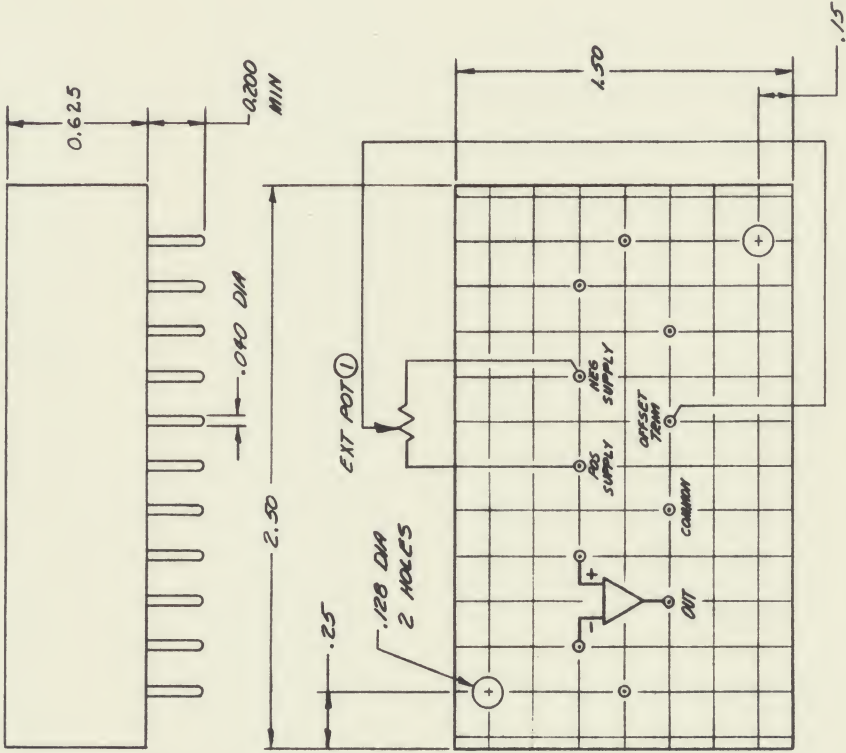
Dimensions	4.50 x 8.00 inches (Mount on 1 inch centers in CDI "IPAC" modules.) Compact metal plug-in case package also available.
Connections	18 pin Varicon
Output Voltage	$\pm 10V$
Output Current	$\pm 30$ ma (short circuit protected)
Power Supply Requirement	$\pm 16VDC$ at 15 ma plus load current $\pm 15VAC$ for chopper drive
Max freq. for $\pm 10V$ swing into 1K load	15KC
Output Impedance	Less than .001 ohm
Bandwidth (small signal)	1.5MC
3 db point with 1 megohm source impedance	15KC with 1K load 10KC with 330 ohm load
Gain	$\pm 1 \pm 10$ ppm at DC $\pm 1 \pm 0.1\%$ at 1KC
Input Impedance	Greater than 100,000 Megohm Less than 10pf
Drift (0°C to 50°C)	$\pm 50 \mu V$ (long term)
DC Input Current	$10^{-11}$ amp
Voltage Noise	0-50cps: 50 $\mu V_{pp}$ (20 $\mu V_{pp}$ available) 0-10KC: 100 $\mu V_{pp}$

Printed in U.S.A.



PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
OUTPUT VOLTAGE SWING	330 $\Omega$ LOAD	$\pm 10$	$\pm 11$		VOLTS
OUTPUT CURRENT		$\pm 30$			MA
OPEN LOOP GAIN				150	$\Omega$
MINIMUM FULL POWER OUTPUT FREQUENCY	1 K LOAD	1.5			KC
GAIN DC	1 K LOAD 200HZ				
" 1 KC	"	1500			
" 10 KC	"	150			
" 100 KC	"	1.5			
" 1 MC	"	1.5			
OFFSET CURRENT				$\pm 25$	NA
TEMP. COEFFICIENT	-55°C TO +85°C			5	NA/%
OFFSET VOLTAGE	-25°C TO +85°C			25	uV/%
TEMP. COEFFICIENT				50	uV/%
INPUT IMPEDANCE	1 KC BW			500	K $\Omega$
DIFFERENTIAL INPUT IMPEDANCE				400	K $\Omega$
COMMON MODE INPUT IMPEDANCE				10	M $\Omega$

- ④ POWER REQUIRED -  $\pm 16V$  DC AT 15 MA
- ③ PLUS LOAD CURRENT
- ③ INPUTS PROTECTED AGAINST  $\pm 20V$  COMMON MODE SIGNALS AND 40 V DIFFERENTIAL SIGNALS
- ② TOLERATES CONTINUOUS OUTPUT SHORT
- ② CIRCUIT TO GROUND
- ① OFFSET MAY BE DETERMINED BY A SINGLE RESISTOR CONNECTED TO EITHER THE POSITIVE OR NEGATIVE SUPPLY AS REQUIRED



① PIN LOCATION DIAGRAM  
LOOKING AT PINS ON 0.200 GRID (11 PINS)

COMPUTER DYNAMICS, INC.

Torrington, Connecticut

MODEL 5510-3

DC DIFFERENTIAL OPERATIONAL AMPLIFIER

ENCAPSULATED

BLACK EPAYIN

TOURNAME: 100% TESTED AND APPROVED

Work to figure from Do NOT trace drawing

2X

B-11722

SA 4-14-65

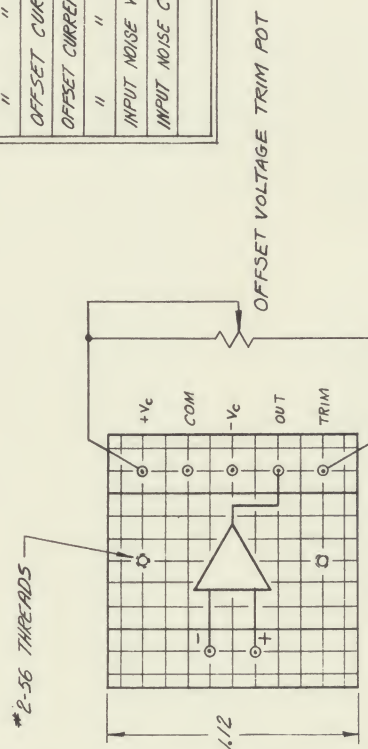
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REVISION

DATE

BY

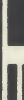
APPROVED



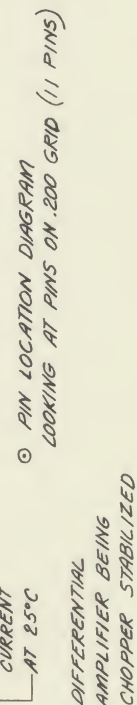
① PIN LOCATION DIAGRAM  
LOOKING AT PINS ON .100 GRID (7 PINS)



PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
VOLTAGE GAIN	$T = -85^{\circ}\text{C}$	10,000			
"	$T = +25^{\circ}\text{C}$	20,000			
"	$T = -5^{\circ}\text{C}$	40,000			
"	$T = +85^{\circ}\text{C}$	80,000			
"	$T = +10^{\circ}\text{C}$	40,000			
"	$T = +25^{\circ}\text{C}$	80,000			
"	$T = +100^{\circ}\text{C}$	40,000			
"	$T = +85^{\circ}\text{C}$	10,000			
"	$T = -5^{\circ}\text{C}$	1.5			MC
UNITY GAIN-BANDWIDTH		10			KC
MAX FULL OUTPUT FREQ	$R_L = 5\text{K}$	$\pm 10$			V
COMMON-MODE VOLTAGE RANGE		5			V
DIFFERENTIAL VOLTAGE RANGE		1000:1			
CMRR		20			M $\Omega$
CM INPUT IMPEDANCE		150			K $\Omega$
DIFF INPUT IMPEDANCE					
OFFSET VOLTAGE DRIFT	$+10^{\circ}\text{C TO } +60^{\circ}\text{C}$			1.5	MV
"	$-25^{\circ}\text{C TO } +85^{\circ}\text{C}$			6.0	MV
OFFSET CURRENT	$25^{\circ}\text{C CMRR EXTERMINAL REFINED TO } 2000$	300			NA
OFFSET CURRENT DRIFT	$+10^{\circ}\text{C TO } +60^{\circ}\text{C}$	150		400	NA
"	$-25^{\circ}\text{C TO } +85^{\circ}\text{C}$	0.5		1.2	$\mu\text{A}$
INPUT NOISE VOLTAGE	$0.016 \text{ TO } 16.0\text{S}$	10			$\mu\text{V}$
INPUT NOISE CURRENT	"	0.5			NA

[illegible]

<p>MATERIAL <i>EPOXY ENCAPSULATED</i></p> <p>FINISH <i>BLACK SATIN</i></p> <p>COATING 100% SOLIDS Break in 10 min. Wick in 10 min.</p>	<p>COMPUTER DYNAMICS INCORPORATED</p>  <p>Torrington Connecticut</p>	<p>SALES <i>2X</i></p> <p>DRAWING NUMBER <i>B-11728</i></p> <p>DATE <i>2-2-65</i></p> <p>APPROVED <i>SA 2-3-65</i></p>	<p>REVISION</p>	<p>THIS SPECIFICATION COVERS <i>DRAWING - MODEL 5565A</i> DC DIFFERENTIAL OPERATIONAL AMPLIFIER</p>
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MATERIAL <u>EPOXY ENCAPSULATED</u> FINISH <u>BLACK SATIN</u> VERIFICATION Check all chip edges, unless otherwise specified Mark in lightest green. Do NOT scale drawing.	 Torrington, Connecticut	COMPUTER DYNAMICS INCORPORATED	TITLE	<u>SPECIFICATION CONTROL DRAWING</u>
				<u>MODEL MS-10-1-400</u>
				<u>CHOPPER STABILIZING AMPLIFIER</u>
			SCALING <u>2X</u>	DRAWING NUMBER <u>B-111730</u>
DESIGNED <u>2/26/65</u>	APPROVED 	REVISIONS Revised		



# COMPUTER DYNAMICS INCORPORATED

## ENGINEERING SALES REPRESENTATIVES

As of May 1, 1965

<u>TERRITORY</u>	<u>REPRESENTATIVE</u>
Alabama	Technical Associates, P.O. Box 1443, Huntsville (205) 536 6611
Arizona	Science Management Corp., 1700 Broadway, Denver, Colorado (303) 222 9558
Calif. (No.)	Garner Laine, Inc. P.O. Box 31388, San Francisco (415) 285 3475
Calif. (So.)	Philip Diamond Enterprises, 13615 Victory Blvd., Van Nuys (213) 873-6822
Colorado	Science Management Corp., 1700 Broadway, Denver, (303) 222 9558
Connecticut	Zaslow Sales Co., Inc., 526 Farmington Ave., Hartford, (203) 236 3265
Delaware	F.R. Jodon, Inc., 4922 St. Elmo Ave., Bethesda, Maryland (301) 652-5110
D.C.	F.R. Jodon, Inc., 4922 St. Elmo Ave., Bethesda, Maryland (301) 652-5110
Florida	Technical Associates, 2319 East South St., Orlando (305) 424 5681
Georgia	Technical Associates, 2319 East South St., Orlando, Florida (305) 424 5681
Kentucky	Rep/Corp, 2077 Embury Park Rd., Dayton, Ohio (513) 278 5885
Illinois (So.)	Burton Sales, P.O. Box 2534, Kansas City, Mo. (816) 523 7865
Indiana	Rep/Corp, 2077 Embury Park Rd., Dayton, Ohio (513) 278 5885
Iowa	Burton Sales, Room 107, 1st Ave. Bldg., Cedar Rapids (319) 366 1931
Kansas	Burton Sales, P.O. Box 2534, Kansas City, Mo. (816) 523 7865
Maine	Zaslow Sales Co., Inc., 526 Farmington Ave., Hartford, Conn. (203) 236 3265
Maryland	F.R. Jodon, Inc., 4922 St. Elmo Ave., Bethesda, Maryland (301) 652 5110
Mass.	Zaslow Sales Co., Inc., 526 Farmington Ave., Hartford, Conn. (203) 236 3265
Michigan	Rep/Corp, 2077 Embury Park Rd., Dayton, Ohio (513) 278 5885
Minnesota	Marvin H. Kirkeby Co., 204 Sunnyridge Lane, Minneapolis (612) 377 3239
Mississippi	Technical Associates, P.O. Box 1443, Huntsville, Ala. (205) 536 6611
Missouri	Burton Sales, P.O. Box 2534, Kansas City, Mo. (816) 523 7865
Nebraska	Burton Sales, P.O. Box 2534, Kansas City, Mo. (816) 523 7865
N. H.	Zaslow Sales Co., Inc., 526 Farmington Ave., Hartford, Conn. (203) 236 3265
Nevada	Science Management, 1700 Broadway, Denver, Colorado (303) 222 9558
New Jersey	Ryan Associates, 213 Edgewood Dr., Westfield, (201) 232 6284
New Mexico	Science Management, 1700 Broadway, Denver, Colorado (303) 222 9558
N. Y.	Ryan Associates, 60 Roger Dr., Port Washington (516) 767 7958
N. Y. (No. & Western)	Counties of Nassau, Kings, Queens, Suffolk, Westchester, Bronx
N. Carolina	R. C. Sturzebecher, 9 Highledge Dr., Penfield (716) 381 4115
Ohio	Technical Associates, 3809 Weona Ave., Charlotte (704) 523 9121
Oklahoma	Rep/Corp, 2077 Embury Park Rd., Dayton, (513) 278 5885
Pennsylvania	Servo Electronics, P.O. Box 20371, Dallas, Texas (214) 357 8309
Rhode Island	Rep/Corp, 2077 Embury Park Rd., Dayton, Ohio (513) 278 5885
S. Carolina	Zaslow Sales Co., Inc. 526 Farmington Ave., Hartford, Conn. (203) 236 3265
Tennessee	Technical Associates, 3809 Weona Ave., Charlotte, N.C. (704) 523 9121
Texas	Technical Associates, 3809 Weona Ave., Charlotte, N.C. (704) 523 9121
Utah	Servo Electronics, P.O. Box 20371, Dallas (214) 357 8309
Vermont	Science Management, 1700 Broadway, Denver, Colorado (303) 222 9558
Virginia	Zaslow Sales Co., Inc., 526 Farmington Ave., Hartford, Conn. (203) 236 3265
Wyoming	F.R. Jodon Inc., 4922 St. Elmo Ave., Bethesda, Md. (301) 652 5110
Canada	Science Management, 1700 Broadway, Denver, Colo. (303) 222 9558
Overseas	Tekni-Tronics, 8 Glanlynn Rd., Pointe Claire, Quebec (514) 695 2579
	International Electro-Comp Co., P.O. Box 353, Pine Brook, N. J. (201) 335 1822



COMPUTER DYNAMICS, INC.  
179 WATER STREET  
TORRINGTON, CONNECTICUT  
TELEPHONE (203) 482-7621

June 21, 1965

PRICE LIST FOR  
SOLID STATE AMPLIFIERS AND ACCESSORIES

CS = Chopper Stabilized  
OLR = Overload Relay  
IMC = Includes Mating Connector

<u>Model No.</u>		<u>Card Dimensions, Inches</u>	<u>Spec. No.</u>	<u>Price (1-9)</u>
2010-1	Diff. $\pm 10V$ , 30 ma, 1.5 mc	2.75 x 7.5	170	\$ 95.00 IMC
2010-2	CS $\pm 10V$ , 30 ma, 1.5 mc	2.75 x 7.5	170	150.00 IMC
Portalog 600 A	$\pm 10V$ Modular Compact Computer		200	(See Spec.)
IPAC	Industrial Process Analog Computer		200	" "
SDA-10	Photo CS Diff. $\pm 10V$ , +30 ma	4.50 x 8.00	190	225.00 IMC
HIP-10	High-Impedance Positive Follower, Photo CS	4.50 x 8.00	220	195.00 IMC
2020-1	Diff. $\pm 20V$ , 20 ma, 1.5 mc	2.75 x 7.5	160	115.00 IMC
2020-2	CS $\pm 20V$ , 20 ma, 1.5 mc OLR	2.75 x 8.75	160	195.00 IMC
2020-3	CS $\pm 20V$ , 100 ma, 1.5 mc OLR	2.75 x 8.75	160	225.00 IMC
2020-5	CS $\pm 20V$ , 20 ma, 1.5 mc	4.50 x 6.5	160	175.00 IMC
2020-6	CS $\pm 20V$ , 20 ma, 1.5 mc	2.75 x 7.5	160	175.00 IMC
2051-S-400	CS $\pm 50V$ , 30 ma, 400 cps	2.75 x 7.5	120	275.00 IMC
2051-U	Unst. $\pm 50V$ , 30 ma	2.75 x 7.75	130	135.00 IMC
2052	Photo-CS $\pm 50V$ , 30 ma	4.50 x 8.00	110	195.00 IMC
2100-3	CS $\pm 100V$ , 15 ma	5.75 x 4.50	150	175.00 IMC
IPAC-3	Amplifier Rack Mount	3 $\frac{1}{2}$ H x 19W x 11D	D/N B-11673	125.00
IPAC-5	Amplifier Rack Mount	5 $\frac{1}{2}$ H x 19W x 15D	D/N B-11750	150.00
SS65A	Potted Diff. Ampl. Commercial	1 1/8 x 1 1/8 x 5/8	240	30.00
SS65AM	Potted Diff. Ampl. Military	1 1/8 x 1 1/8 x 5/8	240	Contact factory
SS10-3	Potted Diff. Ampl.	1 $\frac{1}{2}$ x 2 $\frac{1}{2}$ x 5/8	230	95.00
IS-10-1-400	Potted 400 cps Stabilizer	1 $\frac{1}{2}$ x 2 $\frac{1}{2}$ x 5/8	250	145.00
ISA-1	Shielded Plug-In Ampl. Module for Potted Ampl. (less 15-pin connector)		D/N B-11740	15.00
B-11755	Hold-down bracket for ISA-1 Module		D/N B-11755	10.00
CDI C-264-15	Mating connector for ISA-1 (15 pin)		Cinch 250-15-30-171	2.50

Prices F. O. B. Torrington, Connecticut, U. S. A.